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(54) Latex lid and method for producing the same

(57) In a latex lid, preferably formed of a latex film for a beverage cup or the like, and including a top 21 and a thickened rim 23 around a peripheral flange, an area 33 in the top thinner than the remaining portion of the top is surrounded by a thickened reinforcing ring 32. An opening 3 for a straw is preferably formed in the area 33. The lid is preferably formed on a mould (4 Figs 4, 5) by a dipping process.

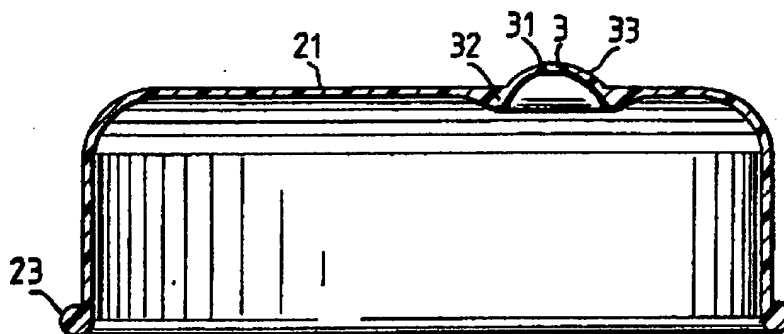


FIG.3

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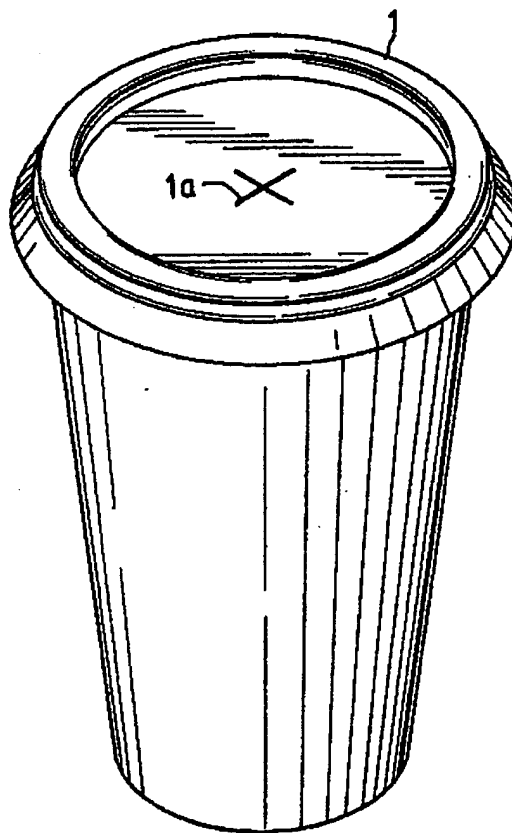


FIG. 1 (PRIOR ART)

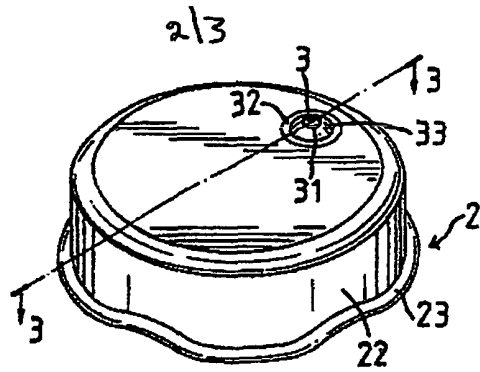


FIG. 2

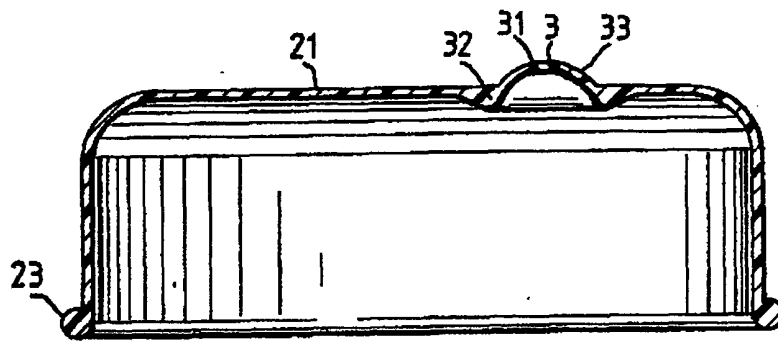


FIG. 3

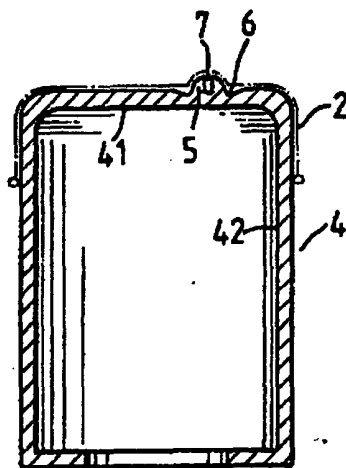


FIG. 4

C

3/3

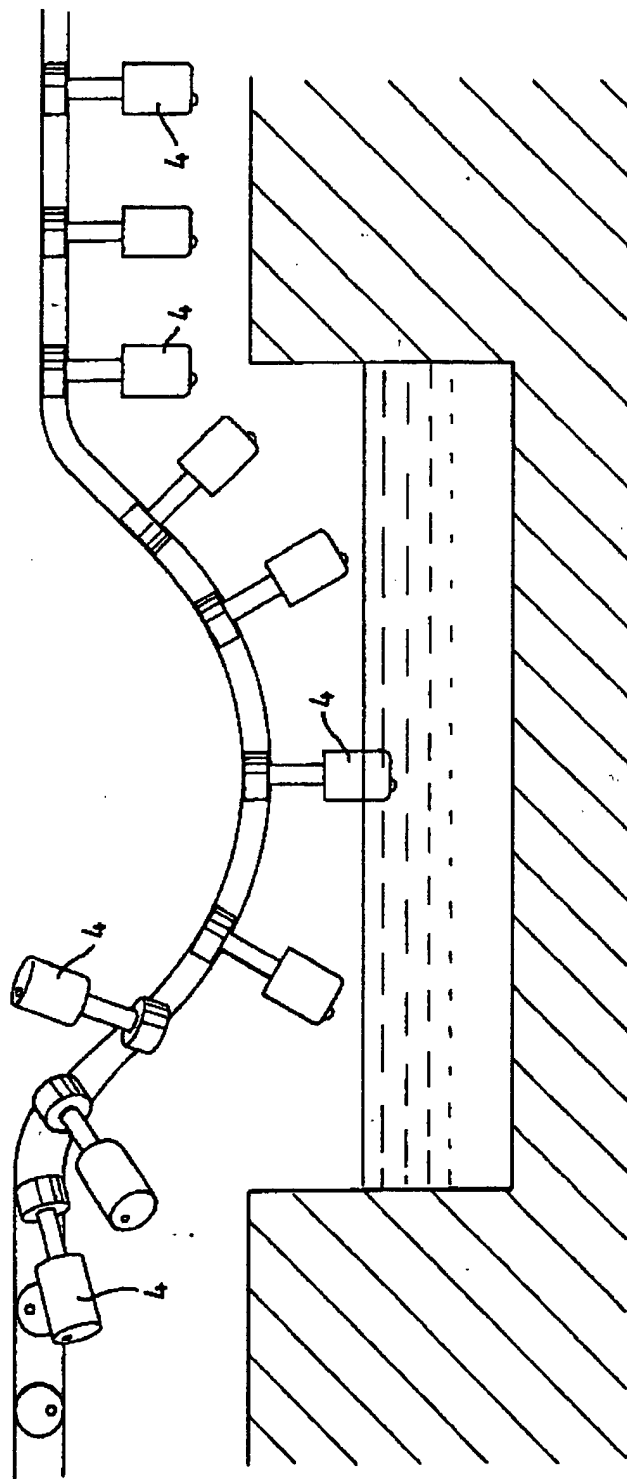


FIG.5

NATURAL LATEX LID AND METHOD FOR  
PRODUCING THE SAME

This invention relates to a lid for a beverage cup, and particularly to a latex lid to seal a beverage cup, having a thinned area preferably with a hole therein for the insertion of a straw.

5 It is known to provide a beverage cup with a plastic lid 1 which has a criss-cross cut 1a therein, as shown in Figure 1, to permit the insertion of a straw. The plastic lid is semi-rigid and non-stretchable and must therefore be manufactured in  
10 different sizes to suit different sizes of cups. Moreover, since such plastic lids are usually made of polystyrene, the used lids create pollution problems when they are discarded or burned.

Another kind of lid used for beverage cups is made  
15 of a latex. The latex lid can effectively seal a cup. It is flexible and stretchable so that a latex lid with a certain dimension can be used for different sizes of cups. However, such a latex lid is not provided with any holes and, therefore, must be pierced with the  
20 end of a straw before the straw is inserted into the cup to which the lid is attached. In some cases, the small torn fragment of the lid created when piercing the latex lid falls into the content of the cup, thus possibly incurring the risk of the user sucking the  
25 fragment into his/her mouth. In many cases, the latex

lid is accidentally torn by the piercing straw, causing the content in the cup to leak out from the tear.

It is an object of the invention to provide a novel latex lid for a beverage cup which overcomes the 5 drawbacks described hereinbefore.

It is another object of the invention to provide a latex lid for a beverage cup with an opening which facilitates the insertion of a straw into the cup. The latex lid of the present invention has the following 10 advantages.

- 1) The lid can effectively seal off the cup associated therewith.
- 2) Although the straw hole is in the lid, the liquid in the cup does not leak through the hole when the 15 cup is full because a vacuum is created in the cup. The hole is specifically dimensioned so that a straw can thread through the hole without leaving any clearance therearound.

The lid is stretchable and thus can accommodate 20 different sizes of cups.

- 4) The lid is made of a natural rubber latex which degrades naturally and is formed into bacteria digestible proteins.
- 5) The lid will neither become destroyed nor produce 25 toxic substances when heated in a microwave oven.
- 6) The stretchable characteristic of the lid is not

changed when the lid is refrigerated.

According to the present invention, a method for making a latex lid comprises: (a) preparing a latex composition; (b) forming by using the latex composition  
5 a cap-like lid having a top, and a peripheral flange turned downwardly from the top; (c) forming an area which is thinner than the remaining portion of the top of the lid; (d) forming a thickened reinforcing ring around the thinner area; and (e) forming a thickened  
10 rim around the peripheral flange of the cap-like lid. The method may further include (f) forming an opening with a thickened marginal edge in the thinner area.

In one aspect of the invention, the step (b) is performed by employing a dipping process, and the steps  
15 (c), (d) and (f) are accomplished by depositing the latex composition as a layer on a molding face of a mold having a stubby projection and a recessed sink surrounding the stubby projection, and creating an opening in the layer deposited on the stubby  
20 projection. The stubby projection is provided with a blind hole and the opening is created by causing the layer deposited on the stubby portion to burst by a gas pressure within the hole. The step (e) is performed by rolling the peripheral end of the flange of the cap-  
25 like lid through the effect of a friction roll.

The formed cap-like lid is preferably made of a natural latex and is stretchable. The lid has a top,

a peripheral flange turning downward from the top, and a rolled rim around the peripheral flange. The top of the lid is provided with an area which is thinner than the remaining portion of the top of the lid for the ease of inserting a straw. Preferably, an opening with a thickened marginal edge therearound is formed in the thinner area of the top, and a thickened reinforcing ring is formed in the top around the thinner area for the purpose of preventing the lid from tearing. The preferred diameter of the opening is about 0.2mm - 1.6mm.

The present exemplary preferred embodiment will be described in detail with reference to the accompanying drawings, in which

Figure 1 shows a conventional plastic lid for a beverage cup;

Figure 2 is a perspective view of a latex lid embodying the present invention;

Figure 3 is a sectional view taken along line 3-3 of Figure 2;

Figure 4 is a sectional view of a mold used to fabricate the latex lid of Figure 2; and

Figure 5 is a schematic view showing the dipping operation in the method according to the present invention.

Referring to Figures 2 and 3, a latex lid according to the present invention includes a molded

cap-like piece 2 of a latex film having a top 21, a peripheral flange 22 turning downward from the top 21, a rolled rim 23 along the peripheral flange 21, an opening 3 formed in a thinned area 33 of the top 21, a thickened marginal edge 31 around the opening 3, and a thickened reinforcing ring 32 in the top 21 around the thinned area 33.

The latex lid is fabricated from a latex composition, preferably a natural latex composition.

10 The process for the fabrication of the latex lid includes the steps of: forming a cap-like lid 2; forming a thinned area 33 with an opening 3 in the top 21 of the cap-like lid; forming a thickened marginal edge 31 around the opening; and forming a thickened reinforcing

15 ring 32 around the thickened marginal edge 31. The above steps are accomplished by a dipping process.

An example of the method of making the latex lid is illustrated hereinafter.

#### EXAMPLE

20 A natural latex composition is prepared by using the following ingredients:

	Ingredients	parts by weight
25	Liquid natural rubber latex (Hevea Brasiliensis) 60% dry rubber content	167
	50% Sulphur dispersion	3.0
	50% Active zinc oxide dispersion	0.8

	50% Accelerator dispersion	1.8
	50% Antioxidant dispersion (butylated reaction product of p-cresol and dicyclopentadiene	2.0
5	Potassium laurate (20%) solution	1.5
	Ammonium cassinate (15%) solution	2.0
	Antiweb-WB agent	1.0
	Antitact-BJL-A	2.4
	10% potassium hydroxide solution	10.0
10	Pigment	a suitable amount
	Flavour	a suitable amount
	Water (to adjust the latex concentration to the required 36 $\pm$ 1% total solid content)	

A coagulant solution is prepared as follows:

15	Components	Weight percent
	Calcium nitrate	3 - 5%
	Wetting agent	0.5 - 1.0
	Water	88.0 - 91.5

The mold used in this example is a hollow body 4  
20 shown in Fig. 4, having a top forming face 41 and a  
side-forming face 42 extending around and turning  
downward from the top forming face 41, a stubby  
projection 5 extending upward from the top forming face  
41, and a shallow annular recessed sink 6 provided in  
25 the top forming face 41 around the stubby projection 5.  
A blind hole 7 which opens upward is provided in the  
stubby projection 5.

A plurality of molds 4 are mounted on a moving  
bracket 8 which moves along a guide rail 9 to advance

the molds 4 to the containers which separately receive the coagulant and the latex solution. The advancing operation is known and will not be detailed herein. The latex solution is stirred at 15 rpm for about 36 5 hours, and the coagulant solution is heated up and maintained at 45 - 50 deg C. The molds 4 are passed through a first oven maintained at 100 deg C and then cooled down to 50 - 60 deg C.

The molds 4 are first sent to the coagulant 10 container and dipped into the coagulant with a dwell time of about 5-8 seconds. When the molds 4 enter the coagulant container, they are held in a position in which the axis of the mold 4 is inclined at a certain angle, preferably 45 deg, relative to a vertical line. 15 When each mold is withdrawn from the coagulant, it is also placed in the 45 deg inclining position. After each mold is withdrawn, the mold 4 is turned to make the top face 41 thereof face upward and is rotated at a high speed so as to remove the excess coagulant and 20 keep a uniform film layer on the molding face of the mold. The mold coming out from the coagulant is turned so that the top face 41 thereof lies horizontally and is moved to a second oven kept at a temperature of 80-90 deg C and then cooled down to 50-60 deg C.

25 Afterwards, the molds are advanced to the latex container and dipped into the latex solution which is kept at 28-30 deg C, where the molds dwell for about 5-

10 seconds. When the molds enter the container, they are also inclined in the same manner as they were in the coagulant tank. After the molds are withdrawn from the latex container, the top faces 41 of the molds are 5 turned upward and the molds are again rotated at a high speed so as to keep a uniform latex layer on each mold 4. The withdrawn molds with their top faces 41 lying horizontally are advanced to a third oven which was maintained at 90-100 deg C to gel the latex. The 10 molds heated by the third oven are first passed through a beading station where the peripheral ends of the latex lid films which have been halfly hardened in a gel state are rolled by friction rollers, then a water-leaching station which is maintained at 75 deg C for 15 the removal of all possible remaining coagulant and other undesirable substances from the latex, and a curing oven maintained at about 120 deg C so as to completely cure the latex film. The cured latex lids are cooled down to 60-70 deg C. Finally, the formed 20 latex lids are removed from the molds.

The latex lids formed on the molding faces 41 and 42 of the mold 4 which have been dipped into the latex solution have the configuration as that shown in Figure 2. The opening 3 in each latex lid 2 is created in the 25 portion which is deposited on the stubby projection 5 of the mold 4 when the mold is heated by the third oven to 90 deg C - 100 deg C. At the temperature of the third oven, the gas pressure within the blind

hole 7 increases, causing the film layer covering the blind hole 7 to burst. As the film layer covering the blind hole 7 bursts, the latex accumulates on the rim of the blind hole 7 due to the effect of the diffusion and the surface tension of the latex, therefore the thickened marginal edge 31 is formed, defining the opening 3. The thickened reinforcing ring 32 is formed from the latex deposited in the shallow recessed sink 6 of the mold 4.

10     Actually, when the mold 4 passes through the latex container in the dipping operation, the top 21 of the mold 4 faces or inclines downward. The latex covering the surface of the stubby projection 5 of the mold 4 is more likely to be spun away therefrom than the  
15 remaining portion of the deposited latex due to the gravitational force and the centrifugal force created by the rotation of the mold 4 at a certain speed when the mold 4 is withdrawn from the latex container and the top face 41 of the mold is turned  
20 upward quickly. Therefore, the latex film covering the stubby projection 5, i.e. the area 33 between the marginal edge 31 and the thickened reinforcing ring 32, is thinner than the remaining portion of the latex film, and more latex is retained in the shallow annular  
25 recessed sink 6 forming into the thickened reinforcing ring 32.

The surface of the thickened marginal edge is

smooth. Usually, the insertion of a straw through the lid into the cup will not tear such a marginal edge. Even if a tearing of the latex film between the thickened marginal edge around the opening and the thickened reinforcing ring is caused by the insertion of a straw, the thickened reinforcing ring will restrict the tearing because the latex film surrounding the thickened reinforcing ring on the top of the lid is thicker than the area 33 of the lid. Moreover, the latex film surrounding the thickened reinforcing ring holds firmly this reinforcing ring thereby preventing the lid from being torn and dropped into the cup as may be occurred in the known latex lid described hereinbefore.

In order to form the opening 3, the gas pressure in the blind hole 7 must increase to an extent sufficient to burst the film layer covering the blind hole 7. In other words, the difference between the gas pressure within the blind hole 7 and the external pressure must be sufficiently large to cause the film layer to burst.

The pressure difference depends on the temperature to which the mold is heated after being dipped into the latex container, i.e. the temperature of the third oven in this xample. The pressure difference can be estimated from the following expression of th ideal gas law:

$$PV = nRT$$

Assuming that V, n & R are constant, then

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

5 where V is the volume of the gas inside the blind hole 7, T<sub>1</sub> is the temperature of the latex container, P<sub>1</sub> is the pressure in the blind hole 7 at the temperature T<sub>1</sub>, T<sub>2</sub> is the temperature of the third oven, and P<sub>2</sub> is the pressure in the blind hole 7 at the temperature T<sub>2</sub>.

10 P<sub>1</sub> is equal to the pressure outside the blind hole, i.e. 1 ATM (atmospheric pressure). Suppose that T<sub>1</sub> = (273+29) deg K, i.e. 29 deg C, and T<sub>2</sub> = (273+95) deg K, i.e. 95 deg C, then P<sub>2</sub> will be 1.22 atm. Therefore, the pressure difference is about 0.22 atm.

15 The surface tension of the latex film depends on the concentration of the latex solution. The concentration of the latex solution is so chosen that it produces a force of surface tension less than the force to burst the film layer, i.e. the force created  
20 by the pressure difference. The total solid content of the latex solution used in this example 36 ± 1%.

The diameter of the opening 3 in the mold is chosen such that it can not be greater than the diameter of a straw. Preferably, the diameter of the  
25 opening 3 is less than 1.6mm.

In this example, the diameter of the blind hole 7 is 1.2mm, the depth of the blind hole 7 of the mold is

about 2mm, and the diameter of the shallow recessed sink 32 is about 3.0 - 9.0mm. The bursting force  $\Delta F$  which is created in the blind hole 7 can be determined mathematically from the expression:

5  $\Delta F = \text{pressure difference} \times \text{the cross-sectional area of the blind hole 7} - \text{the surface tension of the film layer covering the blind hole 7} \times \text{the circumference of the opening 3,}$

10 i.e.,  $\Delta F = (\Delta P) A - \gamma (\pi D)$

For example, if the total solid content of the latex solution is 60%, the specific gravity thereof is about 0.9504 g/cu.cm and the surface tension thereof is about 35 dyne/cm (from the related literature).

15 Since  $P = 0.22 \text{ atm}$ ,  $A = \pi \left(\frac{D}{2}\right)^2$ , where  $D = 1.2 \text{ mm} = 0.12 \text{ cm}$ , the bursting force  $\Delta F$  is 243.27 dyne.

With the invention thus explained, it is apparent that various modifications and variations can be made without departing from the scope of the invention. It  
20 is therefore intended that the invention be limited only as indicated in the appended claims.

## CLAIMS:

1. A method for making a latex lid comprising:
  - (a) preparing a latex composition;
  - (b) forming by using the latex composition a cap-like lid having a top, a peripheral flange turned downwardly from said top;
  - (c) forming an area which is thinner than the remaining portion of said top;
  - (d) forming a thickened reinforcing ring around said area; and
  - (e) forming a thickened rim around said peripheral flange.
2. A method of making a latex lid as claimed in said Claim 1, further comprising (f) forming an opening in said thinner area, and (g) forming a thickened marginal edge around said opening.
3. A method of making a latex lid as claimed in Claim 2, wherein said opening is provided with a dimension just enough for the insertion of a straw.
4. A method of making a latex lid as claimed in Claim 2, wherein said step (b) is performed by employing a dipping process, and said steps (c), (d), (f) and (g) are accomplished by depositing the latex composition as a layer on a molding face of a mold having a stubby projection and a recessed sink surrounding said stubby projection, and creating an

opening in said layer deposited on said stubby portion.

5. A method of making a latex lid as claimed in claim 4, wherein said stubby projection is provided with a blind hole and said opening is created by causing said layer deposited on said stubby portion to burst by the gas pressure within said blind hole.

6. A method of making a latex lid as claimed in Claim 1, wherein said step (e) is performed by rolling the peripheral end of said flange of said cap-like lid.

7. A method of making a latex lid as claimed in Claim 1 wherein said latex composition is a natural rubber latex.

8. A latex lid comprising:

a molded cap-like piece made of a latex film, having a top, a peripheral flange turning downward from said top, a thickened rim around said peripheral flange, said top having an area which is thinner than the remaining portion of said top and a thickened reinforcing ring around said thinner area.

9. A latex lid as claimed in Claim 8, further comprising an opening formed in said thinner area, and a thickened marginal edge around said opening.

10. A latex lid as claimed in Claim 9, wherein said thickened rim is a rolled rim.

11. A latex lid as claimed in Claim 9, wherein said latex film is a natural latex film:
12. A latex lid as claimed in Claim 9, wherein said opening has a diameter of about 0.2 - 1.6 mm.
13. A latex lid as claimed in Claim 9, wherein said thickened reinforcing ring has a diameter of about 3.0 - 9.0mm.
14. A latex lid as substantially described hereinbefore with reference to the accompanying drawings.